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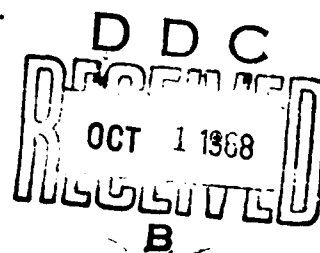
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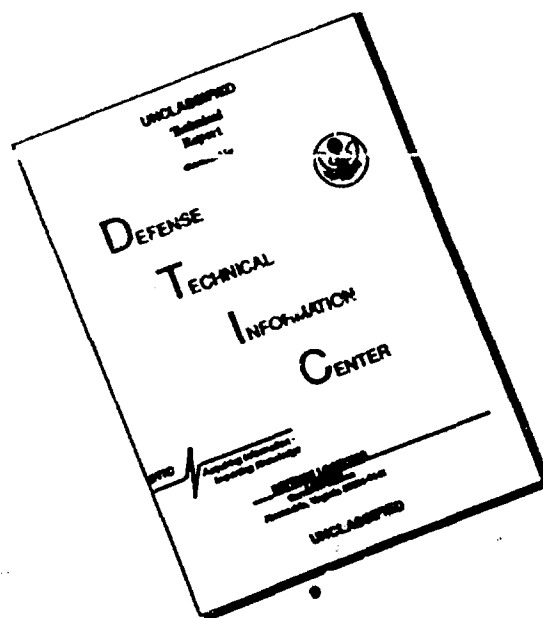


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CONTENT OF SOME TRACE ELEMENTS (COPPER, MANGANESE,
COBALT AND ZINC) IN THE BLOOD, CEREBROSPINAL FLUID
AND URINE OF HEALTHY AND MYOPATHIC PERSONS

[Following is the translation of an article by M.G. Kirienko, Department of Nerve Diseases (Acting Head, Associate Professor G.D. Bobrovskaya) of the Kiev Medical Institute, and Department of Biochemistry (Head, Professor G.A. Babenko) of the Ivano-Frankovskogo Medical Institute, published in the Russian-language periodical Zhurnal Nevropatologii i Psikiatrii imeni S.S. Korsakova (Journal of Neuropathology and Psychiatry imeni S. S. Korsakova), No. 11, Vol LXVI, 1966, pages 1628-1631. It was submitted on 9 October 1965. Translation performed by Sp/7 Charles T. Ostertag, Jr.]

It has been established by the investigations of a number of scientists that microelements trace elements are included in the composition of enzymes and vitamins, and that they influence hormone formation, growth, reproduction and cell division [1-5]. In recent years the study of microelements has attracted the attention of specialists from various branches of medicine. In the literature which has been available to us we have not found any papers dealing with the metabolism of microelements during myopathy. There are only individual reports on attempts at studying this problem in model experiments [6-9].

We thought it interesting to investigate certain aspects of trace element (copper, manganese, cobalt and zinc) metabolism in myopathic persons from the point of view of their participation in the synthesis of nucleic acids and proteins, and the influence on carbohydrate and fat metabolism, and on regulation of the process of tissue respiration [1,3,10,11]. For this we determined the quantitative make-up of the stated trace elements in the blood, serum, cerebrospinal fluid and urine of myopathic patients, and also studied the dynamics of concentration of copper, manganese, cobalt and zinc in the blood and the removal of copper and manganese with the urine in patients during the process of complex therapy.

For a control the same investigations were carried out in a group of persons, who for all practical purposes were healthy: Men, admitted to the neurological section and recognized as practically healthy (based on clinical indication a lumbar puncture was performed on them), and women in the gynecological clinic of the Kiev Medical Institute in connection with oophoritic cysts or myoma of the uterus (subsequent pathohistological investigations supported the benignancy of these formations). The content of trace elements in the biological fluids of this group was accepted as normal.

Blood (7-8 ml) was taken from the ulnar vein on an empty stomach, and the urine for analysis - from the daily volume. In the quest for a pathogenetic treatment, to several myopathic patients we administered vitamin B₁₂ by the endolumbar route. Before this we took spinal fluid (9-10 ml) in which, in addition to the trace elements, we simultaneously determined the morphological composition, globulin reactions, and the sugar content.

The fluid was taken prior to the administration of sovaine into the cerebrospinal canal for pre-operation anesthesia. The pathology was not determined on the patients for organs of the thorax and abdominal cavity; analyses of the blood, fluid and urine were normal. Samples, taken for the analysis, were suspended and calcined in a muffle furnace at a temperature of 450°.

Determination of the quantitative content of copper and manganese in the samples was performed spectrographically with the help of an ISP-22 spectrograph using "closed" electrodes [10]. Zinc and cobalt were isolated from ash samples by the method of Babenko [13]. Quantitative determination of zinc was performed by the polarographic method, and of cobalt - by colorimetry.

We investigated 58 patients (31 men and 27 women) with various clinical forms of myopathy in age groups from 11 up to 51 years, and with antiquity of the disease up to 29 years. The adolescent form of myopathy was present in 34 patients, brachial-scapular-facial - in 11, early infantile - in 4, in 5 of the patients there was a myopathic syndrome, and 4 suffered with neural muscular atrophy.

It can be seen from the table that the content of copper, manganese, cobalt and zinc in the blood of myopathic patients was lowered in comparison with normal. We noted that the level of manganese and cobalt in the blood of patients drops parallelly with the expressiveness of muscular atrophies. The concentration of copper and manganese in the urine of myopathic patients was increased; the highest level of copper in the urine was noted in patients with the early infantile form of myopathy; no dependency was exposed between the content of manganese in the urine and the severity and length of illness.

Under the influence of complex treatment (over a period of a month injections of monocalcium salt of ATP, vitamins B₁, B₁₂, E, proserine; general restorative substances, physiotherapy, exercise therapy), along with an improvement in the general condition, in the majority of patients a tendency was noted for the normalization of the level of copper, manganese, cobalt and zinc in the blood; the average increase in the content of these trace elements in the blood after treatment turned out to be statistically reliable (see table). In the majority of patients during the process of treatment the excretion of copper and manganese with the urine decreased.

As our investigations showed, the content of copper and manganese in the blood serum of patients was lowered in comparison with the control. It was different during the various clinical forms of myopathy. The sharpest lowering in the level of copper in the serum was noted in patients with the early infantile form of myopathy.

As can be seen from the table, there was no significant difference in the content of copper and manganese in the cerebrospinal fluid of sick and healthy persons, however, the limits of individual fluctuations both in the healthy persons and patients were considerable. No dependency was revealed between the severity and antiquity of illness and the level of copper, manganese and zinc in the fluid of patients. In comparison with healthy persons the average content of zinc was $1\frac{1}{2}$ times higher, the concentration of cobalt in the patients was sharply reduced in comparison with the control. Out of 8 patients it was exposed in only 2 (0.85 and 0.81 micrograms %). Apparently it was not possible to detect it in the fluid of the remaining patients - it was beyond the limits of sensitivity of the method.

The lowering in the level of trace elements in the blood and the increased excretion of copper and manganese with the urine are probably connected with dysproteinemia, which is developed in myopathic patients [14-16]. It can be proposed that in the liver there is a disruption in the synthesis of metalloprotein complexes, possibly dependent on the change in the regulating influence of the diencephalic area on the process of protein metabolism [17].

Disruptions in the metabolism of trace elements during myopathy are apparently an aggravating factor in the course of this disease and a partial reflection of those pathochemical processes which lie at the basis of myopathy.

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Content of trace elements in the blood, serum, fluid and urine of myopathic patients and healthy persons

Trace element	Statistical index	Blood			Blood serum		Fluid		Urine	
		norm	before treatment	difference after treatment	norm	patients	norm	patients	norm	before treatment after treatment
Copper (in mg% for ashes)	M m + n - t	9.25 0.24 14 -	2.98 0.37 24 14	4.78 0.71 24 6.7	10.15 1.85 15 -	2.00 0.28 28 2.3	1.02 0.08 21 -	1.11 0.27 12 2 12 2	0.42 0.04 12 -	1.36 0.21 28 4 0.46 - -
Manganese (in mg% for ashes)	M m + n - t	0.56 0.01 14 -	0.42 0.05 25 14	0.11 0.04 25 2.9	1.05 0.04 18 -	0.40 0.06 26 6.6	0.77 0.02 18 -	0.75 0.05 9 2 0.43 0.04 28 10	0.32 0.01 8 -	0.29 - - -
Cobalt (in mg% for dry substance)	M m + n - t	5.48 0.48 10 -	2.63 0.26 30 7.3	1.86 0.05 30 3.7	- - - -	- - - -	2.2 0.28 9 -	Traces	- - - -	- - - -
Zinc (in mg% for dry substance)	M m + n - t	524 21.9 10 -	443 28 28 2.26	60.4 22.9 28 2.63	- - - -	- - - -	439 72.7 8 -	627 135 6 1.89	- - - -	- - - -